Development of the 3rd Generation ECR ion sources*

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The LBNL 3rd Generation ECR ion source has progressed from a concept to the fabrication of a full scale prototype superconducting magnet structure. This new ECR ion source will combine the recent ECR ion source techniques that significantly enhance the production of high charge state ions. The design includes a plasma chamber made from aluminum to provide additional cold electrons, three separate microwave feeds to allow multiple-frequency plasma heating (at 10, 14 and 18 GHz or at 6, 10 and 14 GHz) and very high magnetic mirror fields as shown in Figure 1 and Table 1. The design calls for mirror fields of 4 T at injection and 3 T at extraction and for a radial field strength at the wall of 2.4 T. The prototype superconducting magnet structure that consists of three solenoid coils and six race track coils with iron poles forming the sextupole has been tested in a vertical dewar and summarized in Table 2. After training, the sextupole magnet reached 105% of its design current with the solenoids off. With the solenoids operating at approximately 70% of their full design field, the sextuple coils operated at 95% of the design value which corresponds to a sextupole field strength at the plasma wall of more than 2.1 T.

Table 1. Design characteristics of the prototype superconducting magnet structure.

I.D. of plasma chamber	15 cm
Mirror field on axis	4T, 3T
Mirror-mirror spacing	50 cm
Central field (variable)	0 to 1.0 T
Max. radial field, plasma wall	2.4 T
Min. field, plasma wall	2.0 T

Table 2. Summary of coil tests.

	Sext.	Sol-1	Sol-2	Sol-3
Design current (A)	146	89.6	82.5	59.8
Individual tests				
Max. current (A)	152	64	85	87
Percent of design	104%	71%	103%	145%
Combined tests				
Current (A)	139	50	66	42
Percent of design	95%	56%	80%	70%

Footnotes and References

*Condensed from Proc. 7th International Conference on Ion Sources, Taormina, Italy, Sept. 1997, in press.

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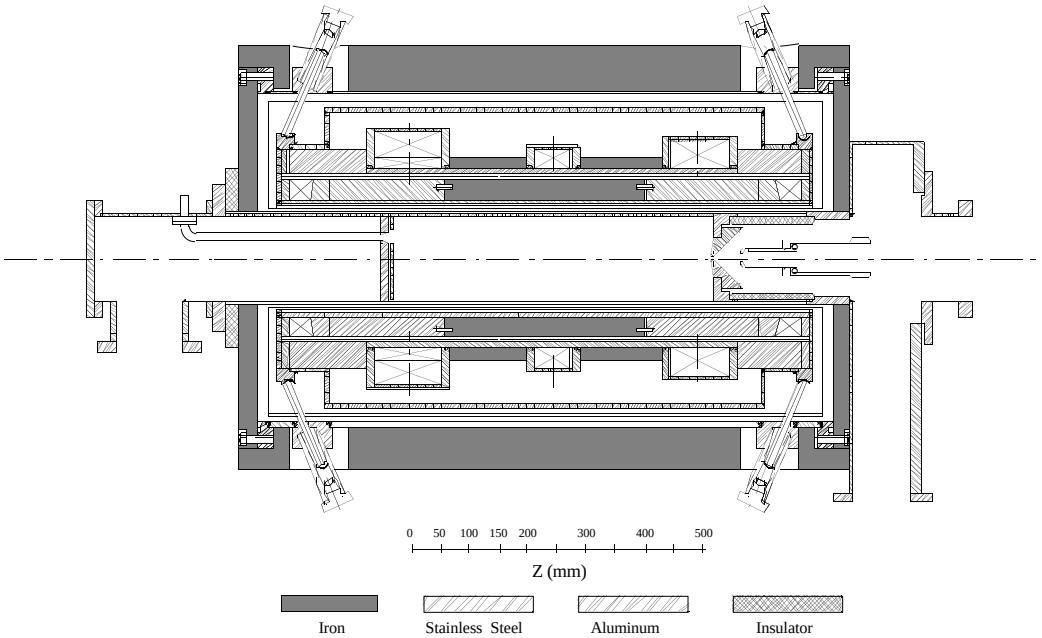

Fig. 1. An elevation view of the 3rd Generation ECR ion source including the iron yoke, coils and plasma chamber.